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CARDE HANDBOOK

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Canada. Defence Research Board,
Canadian Armament Research and
Development Establishment

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ENVIRONMENTAL LABORATORY FACILITIES,

DESIGN WING



DEFENCE RESEARCH BOARD

CANADIAN ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT

Valcartier, Quebec

**ENVIRONMENTAL LABORATORY FACILITIES,
DESIGN WING, C.A.R.D.E.**

**CANADIAN ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT
Valcartier, Quebec**

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PURPOSE OF LABORATORY

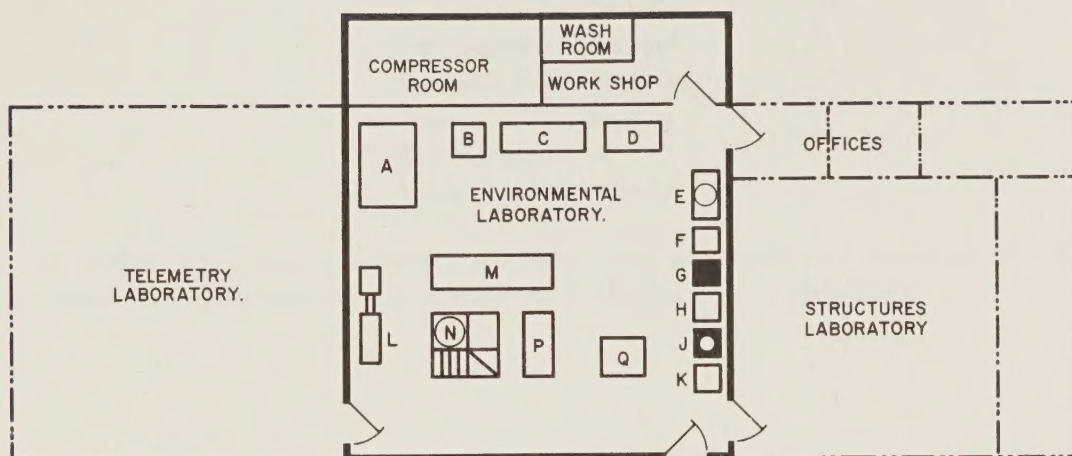
The Environmental Laboratory at CARDE was established to serve three main purposes:

- 1. To prove the satisfactory functioning of components and assemblies under simulated operational conditions.*
- 2. To conduct research into component design and performance.*
- 3. To assess and improve the reliability of complex electronic and electro-mechanical systems.*

The equipment available for these functions and for instrumentation of experiments, located in Building 14, is described in the following pages.

A separate laboratory is being planned for the environmental testing of ordnance components associated with propellants and explosives. A Handbook showing the facilities available will be issued when the laboratory is established.

BUILDING 14 LAYOUT



EQUIPMENT

- A. Tenney Altitude-Temperature Chamber.
- B. Tenney Humidity-Temperature Chamber.
- C. Tinius-Olsen Dynamic Balancing Machine, Model 30-20.
- D. Greer Hydraulic Test Machine.
- E. Calidyne Shaker, Model 174.
- F. Control Console for Calidyne Shaker.
- G. Power Amplifier for Calidyne Shaker.
- H. Control Console and Amplifier, Model 68, for Calidyne Calibrator.
- J. Calidyne Calibrator, Model A6CT.
- K. Ampex 4-Channel FM Tape Recorder.
- L. L.A.B. Vibration Test Stand.
- M. Instrumentation Racks.
- N. Genisco Accelerator Table.
- P. Work Bench.
- Q. Barry Impact Shock Machine.

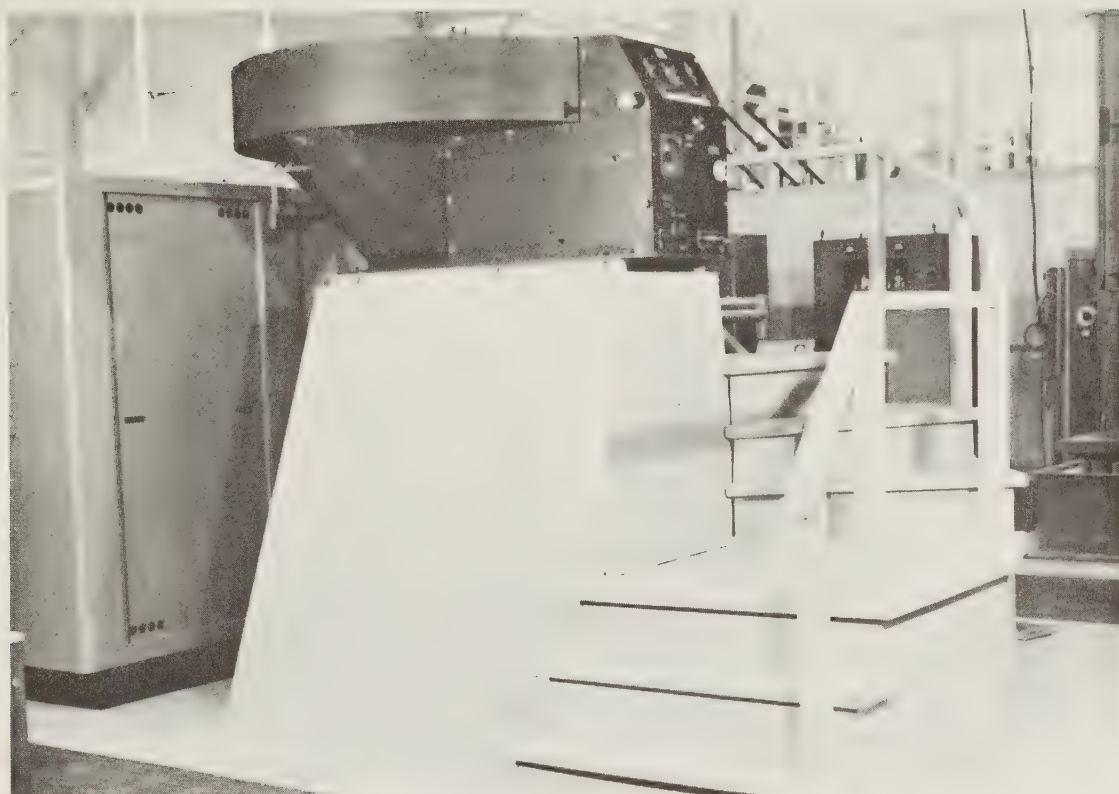
DESCRIPTION AND SPECIFICATIONS OF EQUIPMENT

The laboratory equipment may be classified under six broad headings:

*Acceleration Equipment
Atmosphere Equipment
Dynamic Balancing Equipment
Hydraulic Equipment
Shock Equipment
Vibration Equipment*

As further requirements become clear, additional equipment will be installed. New pages describing additional equipment will be issued for inclusion in this Handbook.

ACCELERATION EQUIPMENT



TITLE: *G-Accelerator, Model B.*

MANUFACTURER: *Genisco Incorporated, Los Angeles, California.*

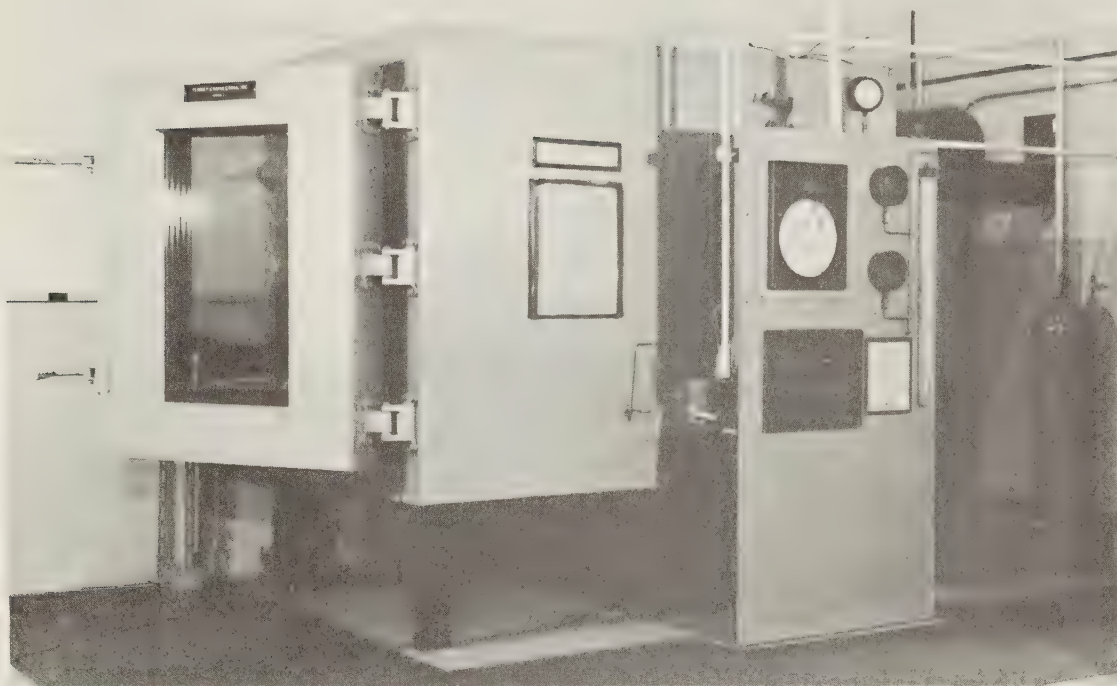
OPERATIONAL LIMITS: *Speed: 5 - 420 r.p.m.
Load: 25 lbs. maximum, up to 8" x 8" x 8" volume.
Force: 120 'g' maximum acceleration (with loads up to 10 lbs)
1200 'g' pounds maximum capacity.
Radius of Gyration: 18" to 26".*

FACILITIES: *8 Shielded Slip Rings for test specimen.
4 Air/Hydraulic Connections for test specimen.
Optical viewing of specimen under load.*

CONTROLS: *Variable Speed Control
Tachometer
Revolution Counter
Timer*

TYPICAL USES: *Application of a steady force to small electrical or mechanical components. Checking operation and calibration of spring-loaded mechanisms.*

ATMOSPHERE EQUIPMENT



TITLE: *Stratosphere Test Chamber, Model ST.36ST-100200.*

MANUFACTURER: *Tenney Engineering Inc., Newark, N.J.*

OPERATIONAL LIMITS: *Pressure: Ambient to .4" Hg. (Approx. 95,000 feet).
Temperature: -100° F to +200° F.
Chamber Internal Dimensions: 3' x 3' x 4'.*

FACILITIES: *2 Air/Hydraulic Connections for test specimen.
8 High-Voltage Terminals for test specimen.
25 Low-Voltage Terminals for test specimen.
2 Co-axial Connectors for test specimen.
12 Thermocouple Wires for test specimen.
Chamber Temperature Recorder.*

CONTROLS *High Temperature Control.
Low Temperature Control.
Vacuum Control.*

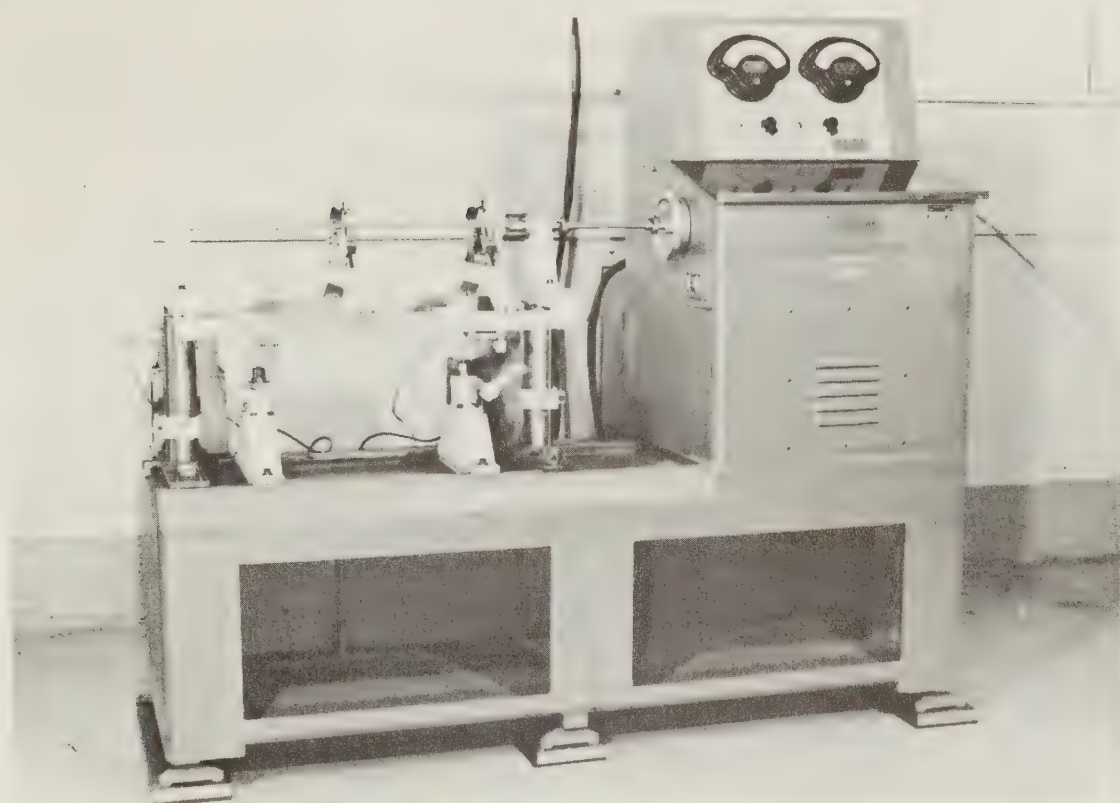
TYPICAL USES: *Assessing performance of mechanical, electrical and electronic assemblies and components under controlled temperature and pressure conditions only. Determining temperature gradients and distributions in test specimens.*

ATMOSPHERE EQUIPMENT (cont'd)



- TITLE:** *Humidity Test Chamber, Model TH. 16*
- MANUFACTURER:** *Tenney Engineering Inc., Newark, N.J.*
- OPERATIONAL LIMITS:** *Humidity Range: 5% to 95%.
Temperature Range: +14° to +200 °F.
Chamber Internal Dimensions: 2' x 2' x 4' .
A 24-hour cycle program is available, if required.*
- FACILITIES:** *Electrical, Hydraulic and Pneumatic Power can be supplied to the test specimen through an access hole.
Wet and dry bulb thermometer recorder.*
- CONTROLS:** *Temperature Controls.
Humidifying Control.
Dehumidifying Control.
Cycle Control.*
- TYPICAL USES:** *Assessing the performance of small components and assemblies under various humidity and temperature conditions.
Corrosion testing.*

DYNAMIC BALANCING EQUIPMENT



TITLE: *Horizontal Static-Dynamic Balancing Machine, Model 30-20.*

MANUFACTURER: *Tinius-Olsen Testing Machine Company, Willow Grove, Pa.*

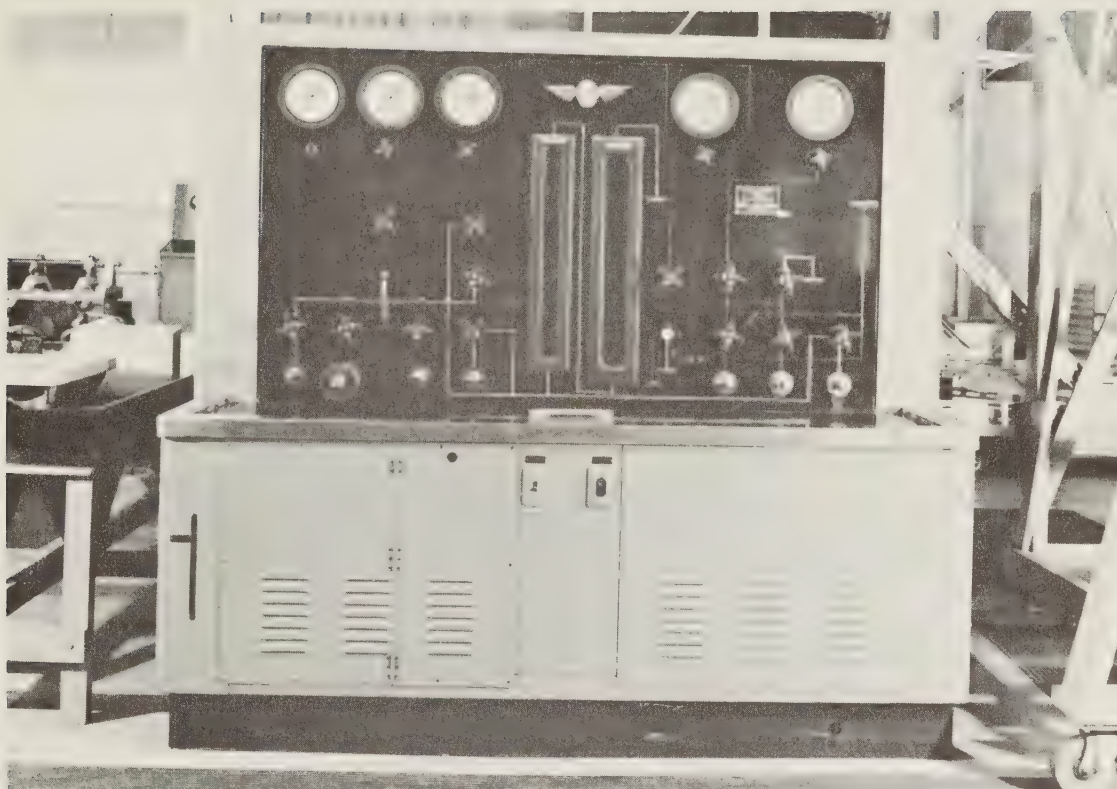
OPERATIONAL LIMITS: *Maximum Diameter of Test Specimen: 20".
Maximum Length of Test Specimen: Approx. 24"
Minimum Weight of Test Specimen: 1.5 lbs.
Maximum Weight of Test Specimen: 50 lbs.
Minimum Pivot Separation: 1".
Maximum Journal Diameter of Test Specimen: 2.125"
Ounce-Inch Sensitivity: .005
Micro-Inch Sensitivity: 12*

FACILITIES: *No contact is possible with test specimen during machine operation.*

CONTROLS: *Unbalance Amount Range Switch.
Unbalance Angle Polarity Switch.
Plane of Correction Selector.
Cradle Frequency Adjusting Bracket.*

TYPICAL USES: *Static and dynamic balancing of mechanical components.*

HYDRAULIC EQUIPMENT



TITLE: *Hydraulic Test Machine, Model 6SE5V-9V.*

MANUFACTURER: *Greer Hydraulics Inc., Brooklyn, N.Y.*

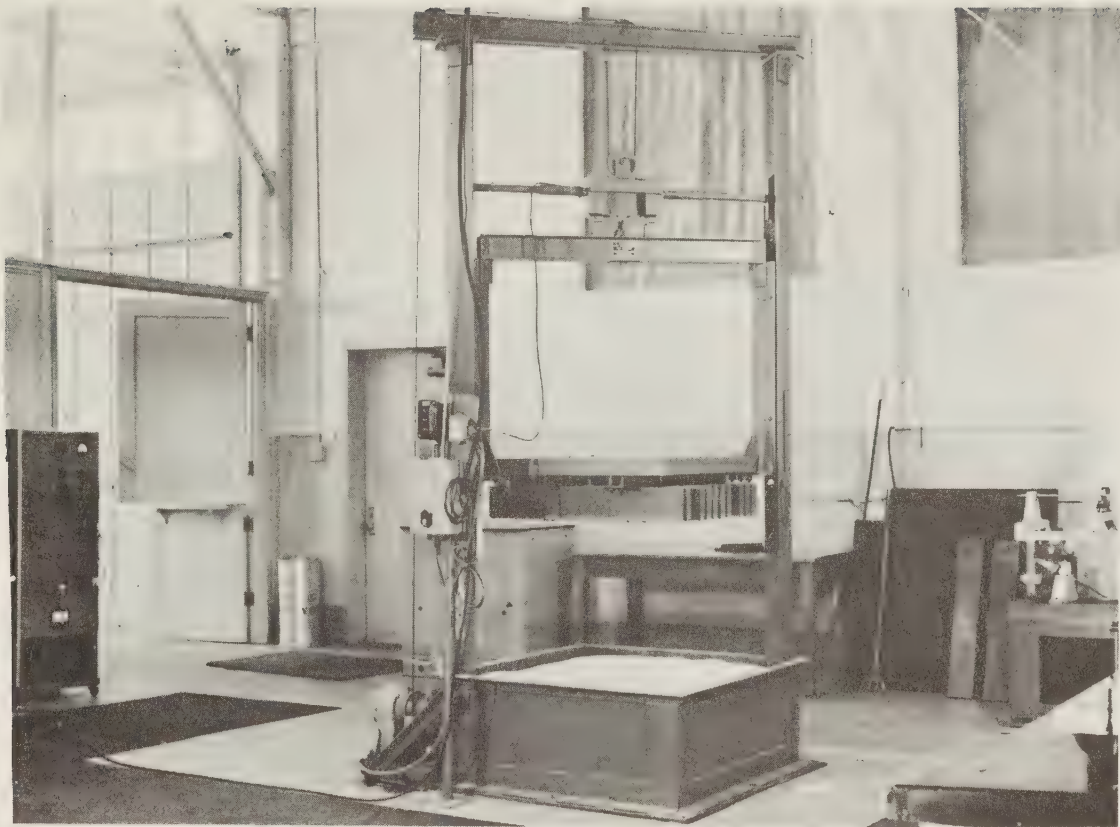
OPERATIONAL LIMITS: *Maximum Oil Pressure: 3,000 psi.
Maximum Oil Flow Rate: 20 gallons per minute.*

FACILITIES: *Four Pressure Outlets.
Two-Stage Precision Flowmeter: .7 g.p.m. to 20 g.p.m.
Water Cooled Oil Reservoir.*

CONTROLS: *Pressure Handwheel.
Selector Controls.
Pressure Compensating Control.*

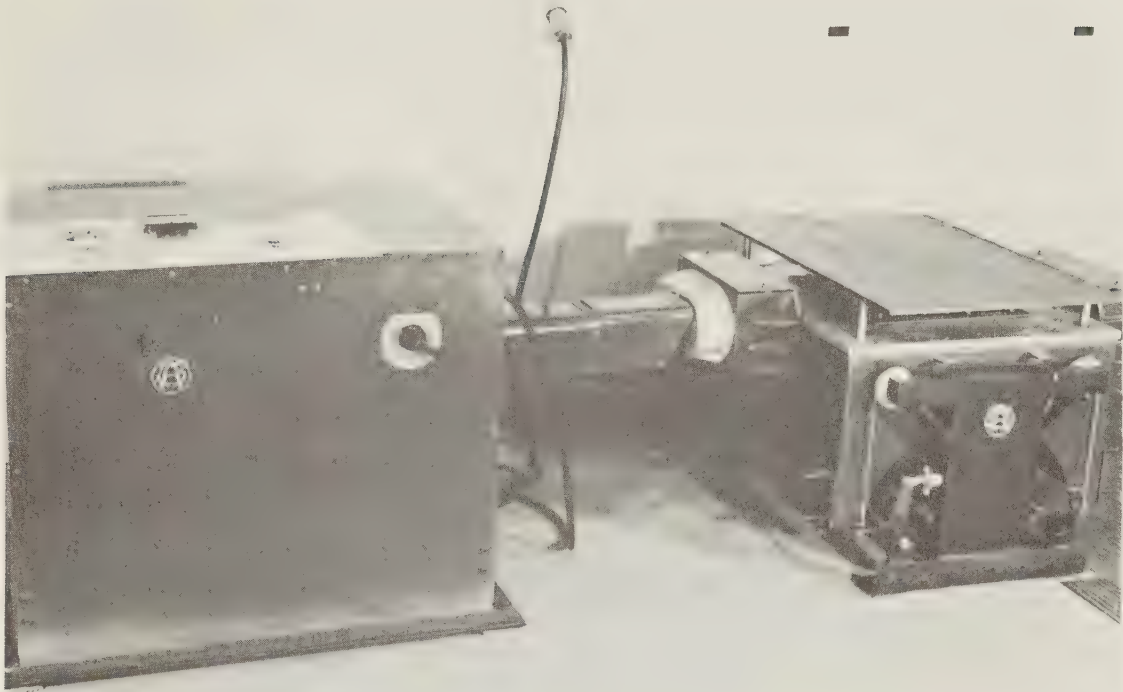
TYPICAL USES: *Pressure testing of hoses.
Testing of pressure vessels.
Testing of pressure operated mechanisms.
Calibration of flowmeters.*

SHOCK EQUIPMENT



- TITLE:** *Medium Impact Shock Machine, Model 150-400 V.D.*
- MANUFACTURER:** *The Barry Corporation, Watertown, Mass.*
- OPERATIONAL LIMIT:** *Load: 150 lbs. to 400 lbs. (Loads less than 150 lbs. require additional ballast).
Height of Drop: Up to 42".
Shock Amplitude: 68 'g' maximum
Shock Duration: 6.5 milliseconds to 32 milliseconds.*
- FACILITIES:** *Electrical, Hydraulic and Pneumatic Power can be supplied to the test specimen during operation, as well as temperature recording.*
- CONTROLS:** *Safety Drop Switch.
Table Elevation Control.*
- TYPICAL USES:** *Impact shock testing of components and structural assemblies.
Ruggedization tests.*

VIBRATION EQUIPMENT



TITLE: *Low Frequency Mechanical Vibration Test Stand, Type RVH-30-300.*

MANUFACTURER: *L.A.B. Corporation, Summit, N.J.*

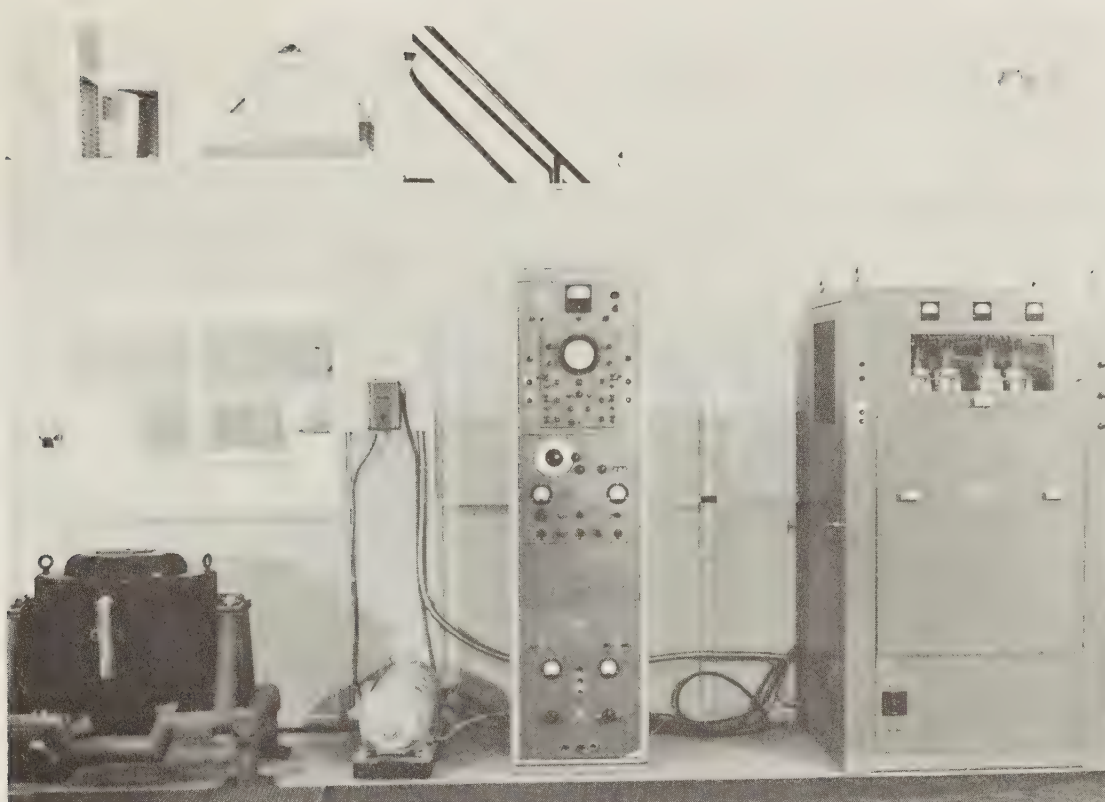
OPERATIONAL LIMITS: *Load: 300 lbs. Maximum (including ballast and counter-weights as required)
Frequency Range: 5 c.p.s. to 100 c.p.s.
Amplitude: ± 0.625 " maximum.
Acceleration: 20 'g' maximum.
Table Top Size: 30" \times 30"
A cycling motor enables the machine to vibrate periodically over a preset frequency range.
Cycling Time: 1 to 60 minutes (depending upon maximum frequency)*

FACILITIES: *Three modes of vibration are available:
Horizontal, Vertical and Circular.
Electrical, Hydraulic and Pneumatic Power and Temperature
Recording can be applied to the test specimen.*

CONTROLS: *Speed Control.
Tachometer.
Frequency Cycle Control.
Amplitude Selection.*

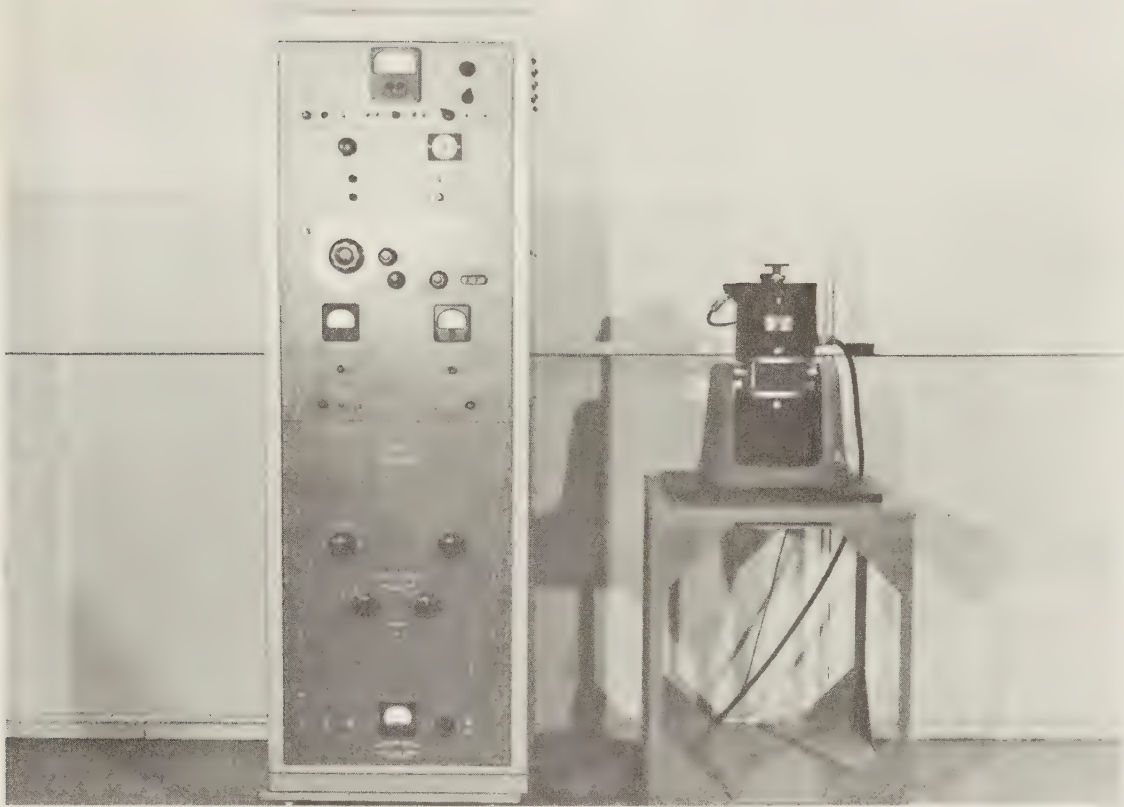
TYPICAL USES: *Assessing the performance of components and assemblies under vibration conditions.*

VIBRATION EQUIPMENT (cont'd)



- TITLE:** *Shaker, Model 174 and Amplifier, Model FG.*
- MANUFACTURER:** *The Calidyne Company, Winchester, Mass.*
- OPERATIONAL LIMITS:** *Frequency Range: 5 c.p.s. to 3,500 c.p.s.
Load: 550 lbs. maximum (Static).
Amplitude: $\pm .25$ " maximum.
Acceleration: 75 g. maximum
Force: 1250 'g' lbs maximum.*
- FACILITIES:** *Electric, Hydraulic and Pneumatic Power can be supplied to test specimens.*
- CONTROLS:** *Frequency, Amplitude, Field Current and Armature Current Controls.
A dual beam oscilloscope allows a continuous comparison to be made between the amplifier input signal and the shaker's response, as reproduced by a velocity pick-up coil.*
- TYPICAL USES:** *For testing electrical or mechanical components and assemblies under vibration.*

VIBRATION EQUIPMENT (cont'd)



- TITLE:** *Calibrator, Model A6CT and Amplifier, Model 68*
- MANUFACTURER:** *The Calidyne Company, Winchester, Mass.*
- OPERATIONAL LIMITS:** *Frequency Range: 5 c.p.s. to 2,000 c.p.s.
Load: 5 lbs. maximum (Static).
Amplitude: $\pm .25$ " maximum.
Acceleration: 50 'g' maximum.
Force: 50 'g' lbs maximum.*
- FACILITIES:** *Electric, Hydraulic and Pneumatic Power can be supplied to specimens.
A servo control enables a constant amplitude or vector acceleration to be maintained over the frequency range.*
- CONTROLS:** *Frequency, Amplitude, Impedance Matching, Power Factor and Field Current Controls.*
- TYPICAL USES:** *Calibration of accelerometers.
Testing small electrical and mechanical components under vibration.*

INSTRUMENTATION AND MEASUREMENT

The type of instrumentation used varies according to the nature of the test under consideration. Electronic methods are employed wherever possible, since these give more flexibility and easier recording and data reduction. Mechanical and electrical instruments, however, are applied in appropriate circumstances.

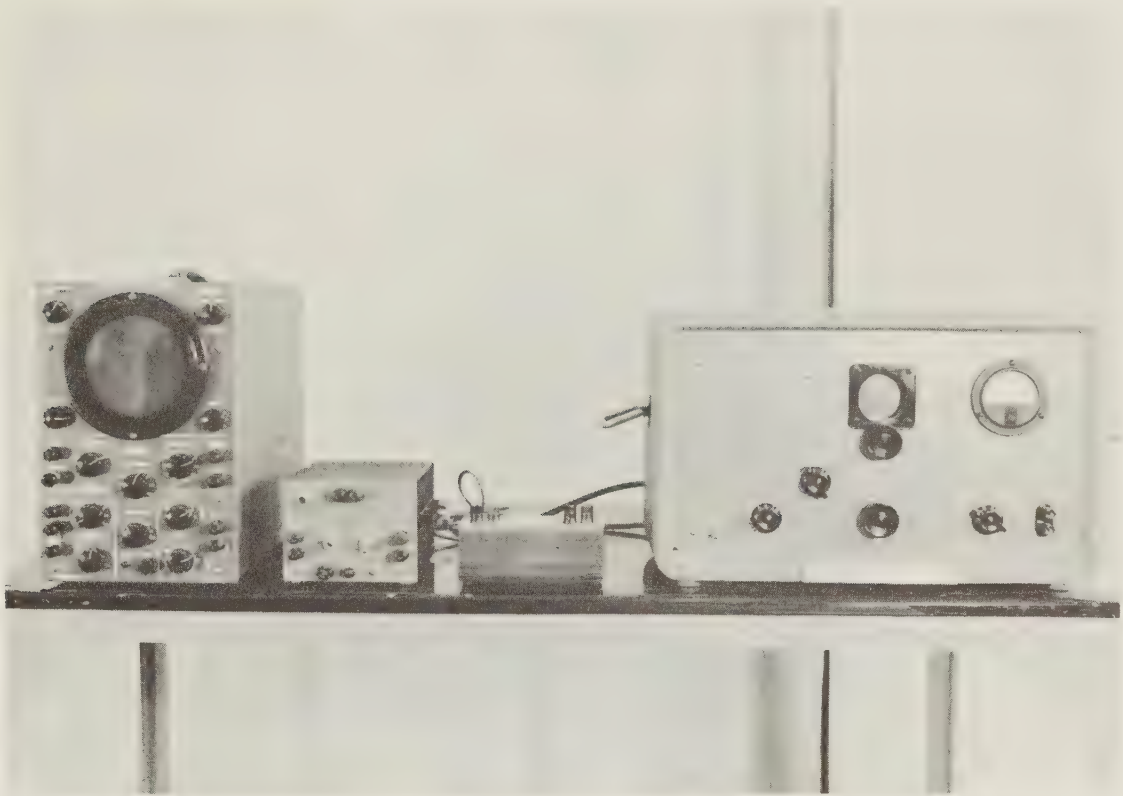
Considerable stocks of instrumentation equipment are held on loan in the laboratory and additional items of all types are freely available from CARDE Instrument Crib.

Measurement of temperature, pressure, strain, displacement, velocity, acceleration and vibration data are normally within the capacity of the laboratory. Accuracies of the order of $\pm 10\%$ are maintained for shock and vibration measurements, for all frequencies up to the high audio range.

Two typical electronic set-ups for measuring vibration and shock are presented together with details of photographic equipment used in these and similar methods. Some information is also given on the methods used for data reduction.

High-speed and special photography, when required, can be undertaken by the CARDE Photographic Section.

TYPICAL VIBRATION RECORDING SET-UP



EQUIPMENT:

*Dumont Type 304, 5" Oscilloscope.
Hewlett Packard Type 650A, Oscillator.
Hewlett Packard Type 400D, V.T.V.M. (Vacuum Tube Voltmeter)
Glennite Model F.407-1, Cathode Follower.*

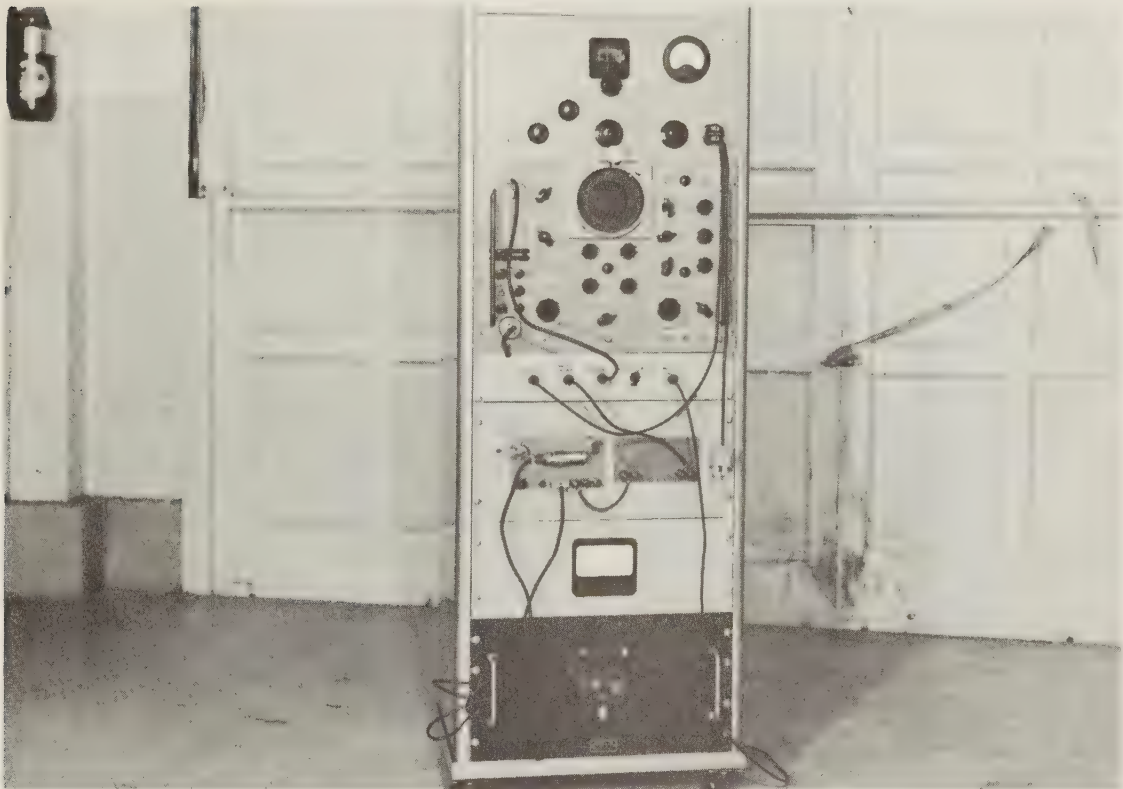
RESULTS:

After data reduction, the following information is obtained regarding the vibration felt by the sensing element:

<i>Frequency</i>	<i>Wave Form</i>
<i>Amplitude</i>	<i>Phase Shift</i>
<i>Acceleration</i>	<i>Amplification or attenuation across test system.</i>

NOTE: Three similar systems are available. These enable simultaneous vibration recordings to be made in three locations or axes.

TYPICAL SHOCK RECORDING SET-UP



EQUIPMENT:

*Lavoie Model LA-239C, 3" Oscilloscope.
Hewlett Packard Model 650A, Oscillator.
Glennite Model F. 407-1, Cathode Follower.
Glennite Low-Pass Filters, as required.*

RESULTS:

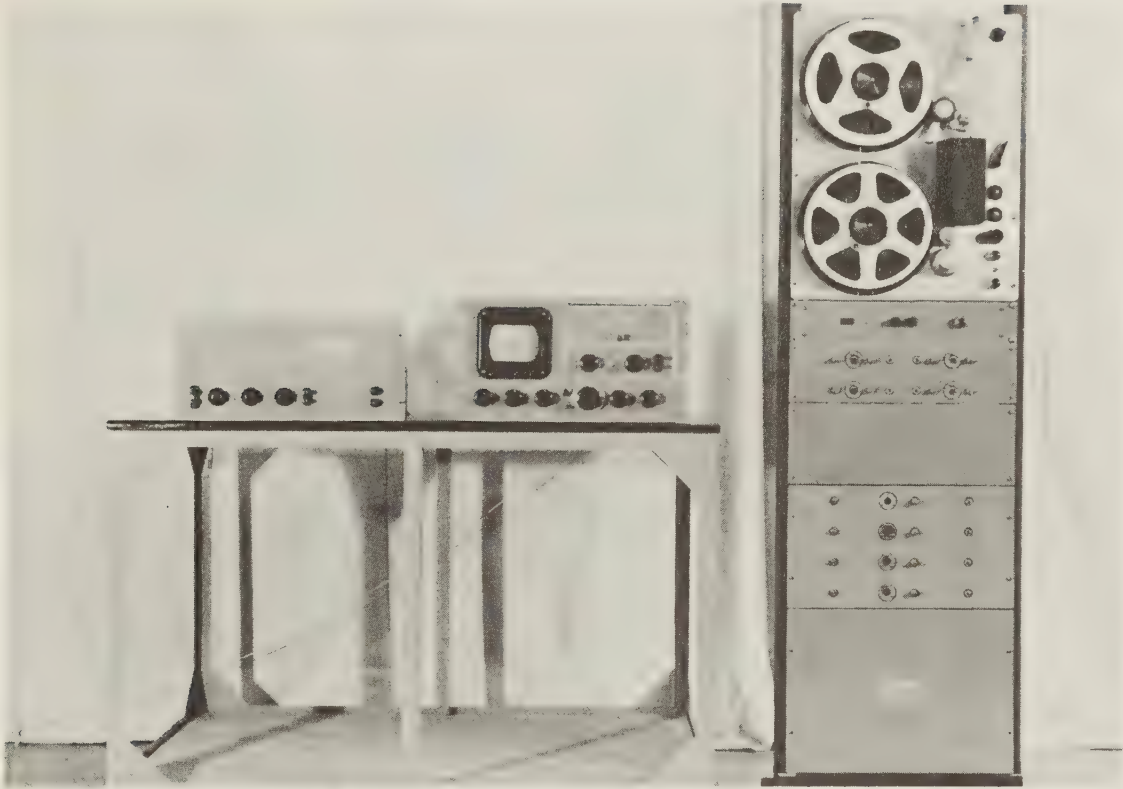
After data reduction, the following information is obtained regarding the shock pulse felt by the sensing element:

*Maximum Amplitude
Maximum Acceleration
Duration of Pulse
Wave Form*

*Pulse Component Frequencies:
including fundamental and
harmonics and high frequency
components.*

NOTE: *Three similar systems are available. These enable simultaneous shock recordings to be made in three locations or axes.*

DATA REDUCTION

**EQUIPMENT:**

*Panoramic Type LP-1, Sonic Analyzer.
Ampex Model 306, 4 Channel Tape Recorder.*

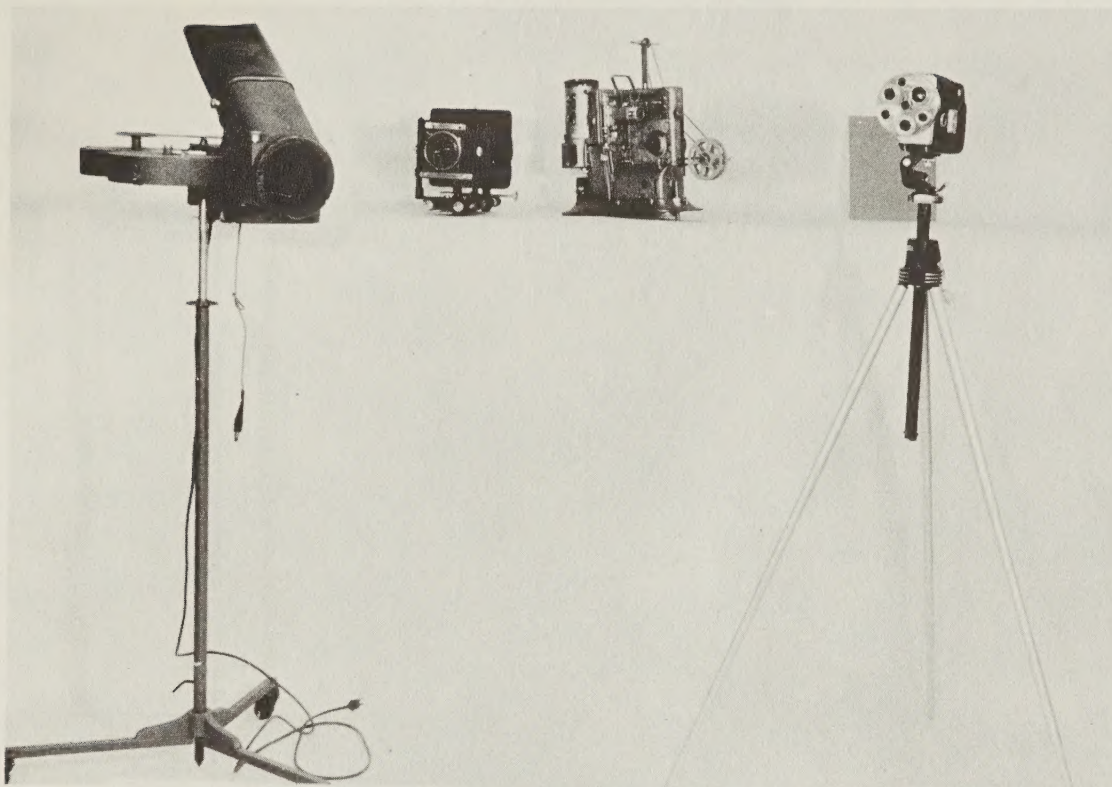
RESULTS:

The Sonic Analyzer, using signals provided by the tape recorder, examines shock and vibration pulses and presents the following information:

*The frequency and relative amplitudes of pulse components.
Details of harmonics of a fundamental frequency.
Detail of 'hash' or ringing frequencies.*

NOTE: *Other means of data reduction are available, including comparison with calibrated signals, band-pass filter techniques and statistical methods.*

PHOTOGRAPHIC EQUIPMENT



EQUIPMENT:

*Dumont 35 mm Continuous Recording Camera.
Hollywood Baco 4" x 5" Cut Film Still Camera.
Kodak K-100 Turret Model 16 mm Cine Camera.
Victor 16 mm Cine Projector.
Tripod, Exposure-Meter and Various Filters.*

TYPICAL USES:

*The continuous recording camera is used for recording a shock-pulse presentation on an oscilloscope.
The 16 mm cine camera will record vandom noise vibration displays.
The still camera is used in conjunction with the Sonic-Analyzer to photograph the components of a wave-form for later analysis.*

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